

Assessing the use of data from non-NOAA sources

A Report from the NOAA Science Advisory Board

January 2012

1 Purpose and Scope

This document provides guidelines for developing a NOAA policy on the use of environmental data from external sources for various mission purposes. It aims to provide the basis for creating a NOAA policy that can aid in deciding whether or not to acquire data from non-NOAA sources and proposes standards to be applied to such acquisitions. Though NOAA has used data from external sources throughout its history, such use has often been on an *ad hoc* basis. The intent of this document is to inform a potential NOAA policy that would apply particularly when external data are relied upon for operational purposes or decision-making.

NOAA's growing activities in observing, analysis, prediction, and response will involve the cooperative use of external data from governmental and non-governmental data sources at both national and international levels. On the Federal level, the long-term objective of creating a national climate portal will involve the cooperative use of large data sets. The Science Advisory Board's Data Archive and Access Requirements Working Group (DAARWG) believes that NOAA has a leadership role to play in this activity. A timely NOAA policy for the use of external data could improve NOAA's data activities and serve as a model for wider collaborative adoption by partners.

DAARWG here presents a list of policy elements in terms of broad principles that could apply NOAA-wide. Specific policies and implementation details will need to be tailored to the needs of various line and program offices. Also, different parts of these guidelines will be applicable to different uses within NOAA so that a tiered approach to a policy may provide the flexibility to match the diversity in NOAA programs.

The scope of these guidelines includes environmental observations and model outputs, as well as socio-economic data. This document does not take into consideration external data that NOAA uses exclusively for administrative purposes.

2 Definitions and existing policies

2.1 Definitions

- **Environmental Data** are recorded and derived observations and measurements of the physical, chemical, biological, geological, and geophysical properties and conditions of the oceans, atmosphere, space environment, sun, and solid earth, as well as correlative data, such as socio-economic data, related

documentation, and metadata. (From NOAA Administrative Order (NAO) 212-15, *Management of Environmental and Geospatial Data and Information* (2003).

- **Socio-economic data** are observations and measurements of the ways humans are affected economically, socially, or culturally by the environment.
- **External sources** include:
 - Other federal agencies
 - State, local, or tribal governments
 - NOAA grantees or contractors
 - Non-governmental organizations (NGOs)
 - Commercial organizations (whether for-profit or not)
 - Agencies of other national governments
 - Research and educational institutions
 - General public (e.g., “crowd-sourcing”)

2.2 Related Policies

- *NWS Policy Directive 1-12* and *NWS Instruction 1-1201*
 - Focus on rights and restrictions regarding data use and redistribution.
 - <http://www.nws.noaa.gov/directives/sym/pd00112001curr.pdf>
- NOAA’s *Web Mapping Application Policy Implementation Guide* contains the following requirements as applied to map data:
 - The data must be necessary for, and material to, the presentation of agency information or the delivery of agency services, and the map must credit the contributing source of the data or provide a direct link back to the third-party source data provider.
 - The data must be relevant and timely, and complete steps must have been taken to ensure that data layers are actively updated to achieve the highest level of quality possible.
- NOAA *Information and Quality Act* (IQA) guidelines require that original data be managed using documented processes for quality control:
 - Check for gross error for data that fall outside of physically realistic ranges (e.g., minimum, maximum, or maximum change).
 - Compare with other independent sources of the same measurement.
 - Examine individual time series and statistical summaries.
 - Apply sensor drift coefficients determined by a comparison of pre- and post-deployment calibrations.
 - Visually inspect the data.
- US Government policies include:
 - Paperwork Reduction Act.
 - OMB *Circular A-130*
 - Federal Acquisition Regulation (FAR)
 - OSTP Policy: *Data Management for Global Change Research* (1991).

3 Introduction

The list of policy elements in the next section are intended to identify issues to consider in developing a policy for the use of environmental data from non-NOAA sources.

A policy based on these guidelines should be used by NOAA projects or programs that wish to obtain environmental data from non-NOAA sources, especially if such data would be used NOAA-wide or in contexts that may affect life, property, or highly influential scientific assessments.

Data policy guidelines should be applied prior to obtaining environmental data from non-NOAA sources. However, in emergency or crisis-response situations it may be necessary to apply modified or no guidelines to meet the occasion.

Each guideline should be assessed for relevance in the context of the project and its broader agency context, the specific data in question, and their intended use. Relevant guidelines should be understood and answered to the satisfaction of the project and any appropriate authorities.

Establishing a policy will put NOAA in a position to provide leadership on the use of external datasets in interagency and international programs. A useful test for these guidelines might be their application in the National Climate Assessment.

4 Policy elements

This section presents a list of policy elements. For each, a brief summary of the DAARWG view is followed by questions to be incorporated into a NOAA policy.

The list is in roughly descending order of priority though generally multiple factors will need to be considered in evaluating sources and datasets. Priority will vary according to the specific use for the data and will likely vary depending on the NOAA element involved.

Some of the items on this list may seem obvious or even elementary. If we have belabored the obvious, it is to assure that all critical points are not overlooked in preparing a policy to use external data in NOAA observing, research, and analysis programs.

4.1 Need for external data

Need should be the paramount factor. Even “free” data encumber long-term life-cycle costs and obligations. A number of questions should be asked to establish that there is truly a need for the external data.

- What are the requirements for the data?
 - Will the data be used NOAA-wide or for a specific project?
 - Will the data serve multi-purpose uses?
 - Multi-purpose data may be more valuable
 - Project-specific use may be less impacted by these guidelines
- Are the data of high value?
 - Will the data inform decisions that may affect life or property?
 - Will the data inform a Highly Influential Scientific Assessment (HISA)?

- Are data available at NOAA to meet the requirements?
 - If not, should this become a new observing requirement?
 - Would using these external data reduce or eliminate the need for an existing or planned NOAA observing system?
- Do emergency conditions apply that justify the use of external data?
 - The *Information Quality Act* defines various exemptions.
 - In cases of emergency, especially when life or property are at risk, and NOAA has identified an external data source that could significantly improve its forecasts, warnings, or analysis, NOAA should make every effort to obtain such data and to make it available to the public.

4.2 Life-Cycle Costs

Life-cycle costs are frequently overlooked or underestimated. NOAA should consider life-cycle costs and evaluate cost-benefit before obtaining data from external sources. An effort should be made to evaluate the amount of each item in the following list as a basis for a cost-benefit estimate. If benefits do not exceed costs, alternative procedures for acquiring the needed data should be explored.

- What is the cost to acquire (purchase price)?
- What labor will be required to adapt information to NOAA's purpose?
- What will be the archive storage and access costs?
- What costs are anticipated for ongoing data reprocessing, recalibration, and version control?
- What will be the continuing obligations for long-term stewardship?
- What labor will be required to prepare and negotiate a memorandum of understanding or other agreement?
- What are possible non-monetary costs?

4.3 Data Rights

NOAA should seek to make its data freely open and available to any government, public, or private entity and provided without restriction on their use and without limitation for further distribution. However, external datasets often come with restrictions on use by NOAA or on redistribution to others. NOAA should strive to make the data it obtains from external sources available to the public without restriction except when the proprietary rights of the data provider outweigh the public interest in having unrestricted access.

The examples of restrictions on redistribution outlined in *NWS 1-1201* may serve as starting point for similar categorization in a NOAA-wide policy.

- What are the restrictions or permissions, if any, with respect to using the data?
 - Are there other data usage conditions?
 - How should NOAA provide credit or acknowledgement to the original source?
 - If necessary, augment metadata to include restrictions on redistribution.
- Do the data include personally identifiable information (PII)?
 - If so, can the PII be made anonymous?
 - If not, does NOAA have the means to safeguard PII?

- Do the data have a security classification?
- Will NOAA redistribute the data to others?
 - Does NOAA have permission redistribute?
 - For example, WMO Resolution 40 defines which data can or cannot be passed on from other National Meteorological Services.
 - Will NOAA incur liability by redistributing the data?
- *NWSI 1-1201* defines three categories of redistribution exemptions that might serve as an example upon which to base a NOAA policy:
 1. Unrestricted: no restrictions: preferred
 2. Temporarily restricted: allows redistribution of archived data
 3. Restricted: Redistribution allowed only if redistribution exemptions apply, as follows:
 - No restrictions on derivative products: mandatory.
 - When required by law: mandatory.
 - With express written permission: strongly recommended.
 - Incidental (allows occasional citations in NWS products); recommended.
 - Emergency (general) (allows redistribution in emergencies such as toxic spills): recommended.
 - Federal agency redistribution: recommended (at least for use throughout NOAA).
 - Redistribution for non-commercial use: avoid if it requires NWS to accept responsibility to determine whether any use is “non-commercial.” Use “with express permission” instead.
 - Long-term expiration of restrictions: (all restrictions on redistribution to expire after 10 or more years): recommended.

4.4 Data Retention

NOAA normally archives its datasets. (NOAA's *Procedure for Scientific Records Appraisal and Archive Approval* provides guidance on what to archive.) However, with the possible development of one or more federated data systems, large datasets may be too expensive to move, and may even be so big that it is impractical to host all data in one location. The result may be distributed-data architecture, with a federated storage system that will require cooperative archiving arrangements.

- What are NOAA's obligations for the long-term archive for the data?
- What guidelines should be established for NOAA participation in a federated data system?
 - If data are not archived at NOAA, can NOAA retrieve archived copies of the data whenever necessary?
 - What are NOAA's obligations to partners in hosting a component of a federated system?
 - In a system used by more than once agency, who will pay for maintaining a federated archive?
 - What safeguards are necessary to assure continuity of a federated system?

4.5 Data Source

NOAA should ensure that data come from a certified and reliable source. A procedure for certifying data sources should be established. Any uncertainty with regard to the data or their source should be documented. If NOAA uses external data for producing products and services that later turn out to be unreliable, NOAA's credibility and reliability may be damaged.

With an external data stream, risks may be associated with problems in the source or network. These can lead to loss of accuracy or reliability in resulting NOAA products and services. Errors in an external data stream may not be detected for some time.

- Does NOAA use require that the data come from a certified [reputable] source?
- If so, what is the process to certify data sources?
 - See, for example, IOOS Data Provider Certification procedure.
- Is the apparent source redistributing data from another source that NOAA should use instead?
- How likely is a sudden loss of the external data stream through network or data-source problems?

4.6 Data Documentation

Data documentation (metadata) must be adequate for immediate and future use. The sources of data, and the procedures used to develop products and services from them, should, as much as practical, be transparently evident. Data might get used for a range of new things and the current metadata may not be adequate. The recalibration of much early satellite data from the 1970s and 1980s reveals that information recorded with them (when the word metadata didn't exist) is wholly inadequate.

- Are the metadata sufficient for initial and future uses?
 - Is the provenance known and documented?
 - How robust are the science algorithms?
 - What quality control procedures are followed?
 - Document the limitations of saved copies of datasets to avoid misuse (e.g. provide quality flags and identify errors).
 - Metadata should be close to the data and bound to the data if possible.

4.7 Data Discovery and Access

For external datasets that are subject to ongoing retrieval, the system for finding and obtaining the data should be standardized to assure reliable access.

- For ongoing retrieval of data from an external source, will data be readily accessible via a standardized protocol in a well-known format?
- For operational use, will the data source be operationally reliable (high availability, redundant)?

4.8 System requirements

NOAA should assure that hardware and software systems are or will be available to carry out the tasks necessary for the effective use of external datasets.

- What software or hardware is required to obtain or ingest the data?
- If accessing the data requires a NOAA receiving system, does that system have the necessary bandwidth and storage capacity?
- What are the personnel requirements? (See Life-Cycle Costs, above.)
- What Modifications to existing processes will be needed?

5 Conclusions

DAARWG endorses the objective to create and implement a NOAA-wide policy for the use of external environmental data.

NOAA already uses external data, provided by partners in many cooperative programs. (See, for example, section 6.1.2, below.) Opportunities to extend cooperative work will likely increase in the future. In particular, the development of federated data systems will allow a more holistic and global approach to environmental data and services. In preparation for that development, NOAA will benefit by preparing a its own policy on using external data. With the experience gained from developing and implementing that policy, NOAA will be well positioned to play a leadership role as national and international collaborative data systems develop.

Effective use of external data may be one element in NOAA's ongoing efforts to keep up with technological and environmental challenges. We are in a period of rapid innovation in information-handling techniques and the public acceptance of them. This will give NOAA the opportunity to improve its approaches to data acquisition and use. Changes in data-stream technology may alter the benefits and risks that may be derived from using external data. A policy on external data use may assist NOAA to flexibly assess the value of using external data as conditions change.

6 Annexes

DAARWG requested the NOAA Environmental Data Management Committee to provide one or two example of existing procedure for using external data. The examples could serve to test the DAARWG advice against the reality of existing practice. The following annexes were provided by National Climatic Data Center and the National Weather Service. They show divergent approaches implementing current policies for the use of external data. The examples underline the point that a NOAA policy will need to be flexible to serve a wide range of data use throughout NOAA.

6.1 National Climatic Data Center (NCDC) criteria

NCDC has established criteria for inclusion of weather and climate data from non-NOAA U.S. networks in NOAA/NCDC climate datasets. These criteria were designed to allow for the inclusion of data from as many non-NOAA networks as possible while ensuring a significant benefit to NOAA customers and adherence to standards of data quality. All costs to NCDC are limited to the internal resource requirements (staff, hardware, and software) necessary for data ingest, quality control, processing, archiving, and distribution.

6.1.1 Criteria

1. Data must be freely open and available to any government, public, or private entity and provided without restriction on their use and without limitation for further distribution.
2. Data should be consistently reported and automated processes must be in place for collecting and distributing data to NCDC on a routine basis; preferably a minimum of once daily for daily or hourly observations.
3. Temporal resolution of data collected and processed at NCDC will include monthly, daily, or hourly observations.
4. For networks consisting of manual observations, an active training program consisting of web-based tutorials or other training aids should provide observing and reporting instruction that is consistent with NOAA or WMO guidelines.
5. Network representatives must be accessible and available to respond whenever necessary to resolve data transfer or data quality issues with NCDC.
6. Network must provide measurements of essential climate variables for which weather and climate needs are not already met by existing NOAA and non-NOAA networks. This will often be in the form of better spatial or temporal coverage of existing climate variables. The volume of data should be sufficiently large to address requirements on a regional or national scale.
7. Network must have an operational quality control program consisting of routine oversight and expert review of reported observations, through either manual or automated processes, to identify and correct large or systematic reporting errors. This program should include a mechanism for providing feedback to observers to inform, train, and improve observing and reporting procedures.
8. For network-owned equipment (e.g., automated mesonets), a maintenance program must be in place for annual and unscheduled maintenance visits, routine equipment calibration and recalibration, and site maintenance. A

network monitoring and quality control program should be linked with the maintenance program to ensure prompt response to equipment malfunctions.

9. Network must provide metadata for each observing station. At a minimum this will include station location, elevation, instrument type, and observation time. A mechanism must be in place to provide NCDC with updated metadata that reflects any instrument or observing change.

6.1.2 Community Collaborative Rain, Hail, and Snow Network (CoCoRaHS)

The Community Collaborative Rain, Hail, and Snow Network (CoCoRaHS) is a network that meets the above criteria and for which NCDC incorporated into its datasets and climate monitoring activities. CoCoRaHS is a non-profit community-based network of more than 10,000 volunteers across the U.S. who report daily observations of rain, hail, and snow using manual observing equipment. The network originated at the Colorado Climate Center at Colorado State University in 1998. The Colorado State Climatologist and staff who oversee the network are routinely available to respond to questions from NCDC necessary for resolving issues associated with data access.

More than 7500 observations are reported in near-real time each day. These data greatly enhance the spatial distribution of precipitation measurements, more than doubling the number of observations available from NOAA networks. Data availability within hours of the observation is especially beneficial to NCDC in monitoring extreme rain and snow events. Each observer enters precipitation measurements into a web-based interface, and the data are transmitted to a central facility via the internet and the Colorado Climate Center makes these data available to NCDC on a continual basis via a web-service. Station metadata also are provided, including station identifier, location, elevation, and observing time.

Observational data quality is assured through a training and education program that includes the use training videos and slide-shows, an interactive web-site, and frequent e-mail communication from the network host providing motivation and observing tips and guidance. The use of the same observing equipment across the entire network ensures consistency of reporting. The CoCoRaHS program maintains an ongoing quality assurance program staffed by meteorologists who identify suspect observations and communicate with observers to determine the validity of the observation and to provide additional guidance as necessary to correct observational deficiencies.

The CoCoRaHS network provides an excellent example of how data from a well established non-NOAA observing network can be used to enhance climate monitoring and dataset development activities that benefit NOAA and its climate customers. The principles applied to CoCoRaHS data can be extended to other networks to increase the number of observations, filling in data sparse areas, and providing data that better meet the user community's needs for high quality and timely climate information.

6.2 National Weather Service Instruction (NWSI) 1-1201

This annex summarizes three appendices to NWS Instruction 1-1201 to provide the DAARWG with a better understanding of the kinds of data NWS obtains from non-NOAA providers as well as clarifying the issues that *NWSI 1-1201* does and does not address.

The NWS instruction does not address concerns such as “accuracy, reliability, reporting formats, update frequency, quality assurance, quality control, or technical requirements such as spatial/temporal resolution.” *NWSI 1-1201* does provide guidance to data acquisition officers in negotiating acceptable terms of use “which data providers might seek as a condition of providing data to NWS.”

NWSI 1-1201 assumes that data acquisition officers will address the technical issues associated with data acquisition and that these issues will be addressed in the data sharing agreement or an appendix to such agreement.

6.2.1 Appendix C to NWS Instruction 1-1201: copy of 2007* Memorandum of Understanding (MOU) between NOAA/NWS/Tropical Prediction Center (TPC) and Weather Predict, Inc.

The purpose of the MOU is to make Weather Predict, Inc. (WP) super-ensemble forecasts available to TPC for the 2007 hurricane season. According to the WP website:

WeatherPredict Consulting provides industry leading tropical cyclone forecasts, for all global cyclone basins, to clients in the insurance, reinsurance, financial, and commodity markets. Further, WPC shares Superensemble™ hurricane forecasts with the US National Hurricane Center, in support of NOAA’s public safety mission.

Our predictions are based upon three key ingredients: the Superensemble, proprietary versions of NOAA’s GFDL tropical cyclone model, and an experienced, highly trained staff of tropical meteorologists.

The [Superensemble™](#) is an intelligent averaging technique that squeezes useful information from an ensemble of objective forecasts to produce optimal guidance for decision makers. The Superensemble™ has significant advantages over simple forecast averaging: it corrects for known biases in the individual objective forecasts, and it weights them to leverage the fact that objective forecasting tools often have regional skill variations.

The most efficient way to improve Superensemble™ forecasts is to improve the individual objective forecasts in the ensemble. These forecasts are derived from computer models, often referred to as Numerical Weather Prediction (NWP) models, which simultaneously simulate the physics of the evolving storm, the surrounding atmosphere, and the ocean below. At WeatherPredict Consulting, we have developed in-house NWP forecasting tools based on NOAA’s GFDL hurricane model. We run these models four times daily to simulate the future of all tropical cyclones on the planet, and the resultant forecasts are key inputs into the Superensemble™ forecasting system.

A SE forecast is completely objective. That is, the forecasting technique does not include human forecasts. Because of this, SE forecasts are ideal when weather

forecasts must serve as inputs to other statistical models, e.g., crop yield forecasts, electricity load forecasts, and consumer demand forecasts. Also of importance, SE forecasts and their associated data sets form an objective basis for probabilistic forecasting. Probabilistic forecasts add value to decision making processes, particularly when examining risk associated with a weather hazard.

SE forecasting requires the management of a large database of weather information. To run SE forecasts, WPC subscribes to, generates, or otherwise acquires raw model outputs from some of the world's foremost meteorological agencies. WP maintains the model forecasts in an ever-growing database of input model forecasts. Additionally, WP maintains a growing database of observed, ground truth meteorological information.

Key terms of the MOU

1. NOAA recognizes proprietary nature of the WP forecasts and agrees to honor restrictions:
 - a. NOAA may redistribute products as long as original content is not readily retrievable
 - b. NWS may reference data and occasionally disclose original data in products that support public safety
 - c. Restrictions will not apply when required by law or with prior written permission from WP.
2. NWS and WP will jointly determine data communication, data coding, and formatting requirements to ensure compatibility
3. NWS will evaluate the WP forecasts and provide to WP along information about TPC model updates and requirements
4. Any NWS public reference to the super ensemble shall acknowledge WP
5. MOU is non-exclusive
6. MOU does not convey rights to NOAA
7. NOAA recognizes "inherent uncertainties" of forecasting and NOAA assumes risk with respect to use of WP super ensemble forecasts

* WP continues to make its super ensemble forecasts available to TPC under subsequent agreements.

6.2.2 Appendix D to NWSI 1-1201: copy of MOU between WeatherFlow, Inc. (WF), and NWS

The purpose of the MOU is to provide NWS with access to data from WF's Hurricane Mesonet. According to the WF website:

The WeatherFlow Hurricane Mesonet is a subset of our complete coastal network of weather stations. It consists of hurricane-hardened weather stations specifically designed to measure hurricane-force winds up to and exceeding 140 miles per hour. This network complements WeatherFlow's standard coastal observing system with a set of hardened and strategically sited stations suited to support multiple applications demanding observed data from hurricanes.

The objective of this new system will be attained by fulfilling three goals: 1) increasing the spatial density of observing sites within the immediate coastal domain, 2) locating these new sites such that they measure true atmospheric

conditions, and 3) installing sites such that they withstand the extreme conditions of a tropical event.

The first phase in building our Hurricane Mesonet involves installing over 100 hardened weather stations in vulnerable areas in the coastal U.S., based on likely storm paths and potential for loss of property and lives. Installations began in April 2007.

Under normal conditions, weather data is transmitted in near real-time via GPRS modem. Data transmissions are encrypted over the air, with each discrete observation record validated by a checksum. If an individual transmission fails, it is re-transmitted at a later date.

The weather data arrives at the central data center on one of several machines in a cluster of processing servers. From there, the raw data and communications are logged to a robust, fault-tolerant file server. Next, raw data is inserted into a database for easier reporting and redundancy. Finally, the raw data is processed through a strict set of quality control and reduction algorithms, and these processed data sets are stored in a separate database for easy presentation on our websites in map and graphical formats.

Physical access to equipment at the data center facility requires technicians to pass multi-layer security control procedures. Entrance to the facility requires a security badge scan and biometric palm-reader scan. Inside the facility a combination door lock must be opened to gain access to WindX hardware equipment. Staff monitors physical access 24x7 by closed-circuit video and alarms. The internal network at the data center is protected by a firewall and intrusion detection/prevention hardware appliances. Remote administration is done through secure encrypted terminal software over a secure encrypted hardware-level VPN tunnel. Software security is monitored through a suite of custom integrated host-based intrusion detection systems. The latest security scanners are used to monitor open ports, filesystem changes, and scan for known vulnerabilities.

The data is regularly archived offsite by compressing and transmitting the raw logs to a geographically separate facility through a secure, encrypted VPN tunnel. The data is stored automatically on hard drives and periodically written to removable optical media.

Key terms of the MOU

1. WF will provide NWS with a feed of its proprietary data at no charge.
2. NWS will make WF data available to all NOAA line offices and NOAA may use data in any manner it chooses, respecting restrictions.
3. NWS will evaluate data and provide feedback to WF regarding quality and parties agree to collaborate to optimize quality of WF data
4. NWS recognizes proprietary nature and agrees to honor restrictions:
 - a. NOAA may redistribute products as long as original content is not readily retrievable
 - b. NWS may distribute WF data in raw form in case of emergencies
 - c. NWS may utilize data with good faith efforts to attribute WF in products that support public safety, even when original data can be extracted

- d. Restrictions will not apply when required by law or with prior written permission from WP.
5. NOAA reserves right to archive data respecting above restrictions
6. WF will provide data in Hourly Metar format with more frequent updates as communications systems allow. WF will provide data in a standard format to facilitate assimilation into NOAA models. No customization of data feed.
7. WF may describe NOAA's expected use of data to prospective observing site hosts
8. Parties may reference partnership in public announcements avoiding implication of NOAA endorsement
9. Non-exclusive

6.2.3 Appendix E to NWSI 1-1201: Excerpts from *Lightning Data Contract between NWS and Vaisala*.

NWS serves as the purchasing agent for several Federal Agencies (DOC, DOD, DOT, DOI, USDA, and NASA) Under the contract, NWS acquires data from Vaisala's National Lightning Detection Network (NLDN) that monitors cloud-to-ground lightning activity across the continental U.S., 24 hours a day year round. According to the Vaisala web site on NLDN technical specifications:

Lightning Data Information

The NLDN® dataset product includes delivery of highest quality lightning data in areas covering the continental United States. The lightning data includes cloud-to-ground stroke information, cloud-to-ground flash information and survey level cloud lightning information.

The lightning data file includes the following information (as a minimum):

- *Date and Time (UTC with milliseconds accuracy)*
- *Latitude and Longitude (location)*
- *Error Ellipse with major and minor semi axis (km)*
- *Peak amplitude (kA)*
- *Polarity (+/-)*
- *Type of event: Cloud or Cloud to Ground designation*

Lightning Data Format

The NLDN® data can be provided in various formats, including but not limited to the following:

- *ASCII*
- *Binary (proprietary Type 97)*
- *XML*
- *Others as requested such as KML, BUFR, GRIB*

Lightning Data Delivery Mechanism

The NLDN® provides the fastest delivery of high quality lightning data over the continental United States. The NLDN® data can be delivered in real-time (less than 15 seconds latency), near real-time (>1 minute bins) or in archive format (>24

hours). The delivery mechanism is via satellite, secure shell Ethernet/internet (TCP/IP), FCP, or 'NOAA' port.

NLDN® Network Specifications

- Thunderstorm detection efficiency in excess of 99%
- Flash detection efficiency greater than 95%
- Median location accuracy of 250-500m or better
- Network uptimes nearing 99.99%
- Data feed uptimes of better than 99.9%
- Event timing precision of 1 microsecond RMS
- Accurate peak current measurements

Key terms of use in the contract

1. FAR 52.227-14, Rights in Data-General
2. Government Agency Data Rights:
 - a. No restrictions on derivative products as long as they do not have sufficient information to retrieve original content of the data
 - b. Restrictions do not apply when required by law or with express written permission
 - c. Section 1.3 of the contract describes various levels of products and data and redistribution rights of the participating government agencies. Level I, II, III, and IV products have sufficient information to enable the original data to be retrieved. Level V products do not.
 - d. USG may redistribute Levels I, II, III, and IV to participating agencies, organizations with which these agencies have working arrangements, foreign countries, and in scientific papers. Internet redistribution allowed to participating agencies through secure connections.
 - e. No restrictions on Level V data redistribution
3. Terms Archiving Lightning Data
 - Data more than 24 hours old
 - Offerer may archive Level I and II data
 - Government reserves right to archive Level III, IV and V data
 - If offerer plans to dispose of data it shall offer data to the government before disposing it
 - Government may archive data in individual agency archives or at NCDC
 - Dissemination of archived data is restricted to participating agencies for Level I, II, III, and IV data. No restrictions for Level V data.

Restrictions may not be lifted for incidental or occasional use or in cases of emergency or for public safety.